Acute and chronic effects of acetaldehyde on learning and memory in mice

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Acetaldehyde has been postulated to mediate several of the behavioral effects of ethanol, including its reinforcing properties. At the highest doses, alcohol disrupts the acquisition and performance of memory tasks, culminating with the blackout experience at high blood alcohol concentrations. However, it remains unknown whether acetaldehyde is involved in such memory impairments induced by acute ethanol. Additionally, chronic alcohol consumption in humans sometimes leads to persistent memory impairments partly due to serious brain damages. The Wernicke-Korsakoff syndrome, characterized by severe anterograde amnesia, is the most serious memory disorder induced by chronic alcohol. The aim of the present study was to show whether acute and chronic treatments with acetaldehyde, the first metabolite of ethanol, lead to similar memory impairments as ethanol in mice.

Memory performances of Swiss and C57BL/6J mice were tested in both the passive avoidance task and the fear conditioning procedure. In the first part of the experiments mice were injected with acute acetaldehyde (50 to 300 mg/kg) immediately after the training phase. In the second part of the experiment, mice were tested for memory performance after 10 daily acetaldehyde injections.

The first part of the experiments shows that acute acetaldehyde administrations produce a strong amnesic effect in both experimental paradigms. Additionally, the amnesic effects of acetaldehyde were more consistent than those observed after ethanol administration. In the second part of the studies, we show that 10 daily acetaldehyde injections to mice led to a severe and persistent anterograde amnesia in both the pavlovian and the operant learning tasks.

In conclusion, acute acetaldehyde produces strong amnesic effects trough yet unknown pharmacological mechanisms. In addition, chronic acetaldehyde administration leads to persistent memory impairments. These results suggest that acetaldehyde might be involved in both the acute amnesic effects of high ethanol doses and the neurotoxic effects of chronic alcohol consumption.